



Atkins, E., Mughal, N. A., Ambler, G. K., Narlawar, R., Torella, F., & Antoniou, G. A. (2020). Is management of complex abdominal aortic aneurysms consistent? A questionnaire based survey. *Journal of Cardiovascular Surgery*, 61(1), 73-77. <https://doi.org/10.23736/S0021-9509.18.10129-7>

Peer reviewed version

License (if available):  
CC BY-NC-ND

Link to published version (if available):  
[10.23736/S0021-9509.18.10129-7](https://doi.org/10.23736/S0021-9509.18.10129-7)

[Link to publication record in Explore Bristol Research](#)  
PDF-document

This is the author accepted manuscript (AAM). The final published version (version of record) is available online via Minerva Medica at <https://www.minervamedica.it/en/journals/cardiovascular-surgery/article.php?cod=R37Y9999N00A18012302> . Please refer to any applicable terms of use of the publisher.

## University of Bristol - Explore Bristol Research

### General rights

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available:  
<http://www.bristol.ac.uk/red/research-policy/pure/user-guides/ebr-terms/>

# **Is management of complex abdominal aortic aneurysms consistent? – A questionnaire-based survey**

<sup>1</sup>Eleanor Atkins

<sup>2</sup>Nadeem A. Mughal

<sup>3</sup>Graeme K. Ambler

<sup>4</sup>Ranjeet Narlawar

<sup>5</sup>Francesco Torella

<sup>1\*</sup>George A. Antoniou

<sup>1</sup>Department of Vascular and Endovascular Surgery and <sup>4</sup>Department of Radiology, The Royal Oldham Hospital, Pennine Acute Hospitals NHS Trust, Manchester, UK

<sup>2</sup>Department of Vascular Surgery, Norfolk and Norwich University Hospitals, Norwich, UK

<sup>3</sup>Division of Population Medicine, Cardiff University, 3rd Floor Neuadd Meirionnydd, Heath Park, Cardiff, UK

<sup>5</sup>Liverpool Vascular and Endovascular Service, Royal Liverpool University Hospital, Liverpool, UK

## **\*corresponding author**

Surgical Offices, Phase 1, The Royal Oldham Hospital, Rochdale Road, OL1 2JH, Oldham, UK

E-mail: antoniou.ga@hotmail.com

**Conflicts of interest:** None

## **ABSTRACT**

**BACKGROUND:** Complex abdominal aortic aneurysm (AAA) is a relatively common presentation to the vascular specialist. Despite this there is little consensus on how to manage the often co-morbid group of patients. Recent advances in endovascular technology have led to the availability of multiple devices, many of which could be used to treat the same aneurysm. The aim of this study was to quantify this potential variability across vascular specialists from multiple countries.

**METHODS:** An online survey was emailed to members of the Vascular Society for Great Britain and Ireland (VSGBI), the Canadian Society for Vascular Surgery (CSVS) and the Australian and New Zealand Society for Vascular Surgery (ANZSVS). The survey presented a vignette of a 63-year-old woman with significant respiratory co-morbidity and a 54 mm juxtarenal AAA (7 mm neck). There were no other adverse morphological features for endovascular repair. The survey included images and questions related to management of the aneurysm.

**RESULTS:** 238 responses were received; 61 from ANZSVS, 65 from CSVS and 112 from VSGBI. VSGBI specialists were significantly more likely to continue surveillance than both ANZSVS (odds ratio (OR) 3.41, 95% confidence interval (CI) 1.61-7.65;  $p < 0.001$ ) and CSVS counterparts (OR 2.61, 95% CI 1.29-5.47;  $p < 0.01$ ). ANZSVS specialists were significantly more likely to perform an endovascular repair than those from CSVS (OR 3.28, 95% CI 1.50-7.40;  $p < 0.01$ ) and VSGBI (OR 3.65, 95% CI 1.81-7.59;  $p < 0.001$ ). CSVS specialists were significantly more likely to manage the aneurysm with open surgery than colleagues from the VSGBI (OR 6.57, 95% CI 2.58-18.46;  $p < 0.001$ ) and ANZSVS (OR 7.18, 95% CI 2.22-30.79;  $p < 0.001$ ).

**CONCLUSIONS:** Significant variation in the management of a juxtarenal AAA between countries was observed. The same patient would be more likely to have an endovascular repair in Australia and New Zealand, open surgery in Canada and continuing surveillance in the UK and Ireland. This variation reflects the lack of long-term evidence and international consensus on the optimal management of complex AAA.

**Keywords:** Abdominal aortic aneurysm - Aneurysm neck - Endovascular aneurysm repair – Endograft - Computed tomographic angiography

## INTRODUCTION

For abdominal aortic aneurysms (AAAs) with a favorable morphology, endovascular repair has become the predominant treatment.<sup>1,2</sup> Open surgical repair remains an option for young or fit patients with adverse anatomic features precluding a standard endovascular aneurysm repair (EVAR),<sup>3</sup> but these cases must be carefully selected. Treatment of complex aneurysms with endovascular procedures is a constantly evolving field, and techniques are being developed to circumvent anatomic constraints such as short or angulated necks. Fenestrated or branched EVAR extends the sealing zone of the graft proximally with custom made stents including windows for the renal and/or visceral arteries. Chimney, periscope or snorkel EVAR requires catheterization of at least one branch vessel in order to place a covered stent that runs parallel to the main body. This technique may also be combined with endovascular aneurysm sealing (EVAS). Standard EVAR devices can be secured with endoanchors in the proximal sealing zone whilst new generation models are being developed allowing their use in a wider range of anatomies. All have been proposed as treatment options for aneurysms with hostile neck anatomy

There is little high level evidence comparing the efficacy of standard and complex endovascular, and open surgical procedures.<sup>4,5</sup> It is perceived that specialists dealing with complex aneurysms may individualize the treatments they offer from patient to patient. This might depend on the experience of the vascular specialist, the expertise of their centre and the preferences of the patient. Our objective was to assess current practice and explore potential variability in the management of complex AAA by conducting a survey among vascular specialists.

## METHODS

A 10-part online questionnaire was composed using the Bristol Online Surveys tool, which is designed for academic research, educational and public sector organizations.<sup>6</sup> An email invitation to complete the questionnaire was sent to all listed members of the Vascular Society for Great Britain and Ireland (VSGBI), the Canadian Society for Vascular Surgery (CSVS) and the Australia and New Zealand Society for Vascular Surgery (ANZSVS). This comprised 650 VSGBI members, 196 ANZSVS members and 155 CSVS members. A reminder email was sent two weeks later and the survey was open for five months from 5<sup>th</sup> September 2016 to 8<sup>th</sup> February 2017. The societies were not involved in the design of the study.

The questionnaire described a brief clinical scenario based on the real-life case of a 63-year old woman referred to the Department of Vascular and Endovascular Surgery in the Pennine Acute Hospitals NHS Trust (Manchester, UK) for management of a 54 mm AAA with a short (7mm) infra-renal neck (Appendix I). There were no other radiological contraindications to standard or complex EVAR. No patient identifiable data was revealed. The clinical description was accompanied by a sagittal and coronal view of the computed tomographic (CT) angiogram presenting the para-renal/visceral segment of the aorta (Figure 1). The patient was unable to complete a cardiopulmonary exercise test due to severe chronic obstructive pulmonary disease and hip osteoarthritis. The questionnaire presented treatment options based on the clinical scenario and CT imaging, including conservative management. It also contained questions relating to the operating facilities in the employing hospital (whether surgeons operate in a hybrid theatre, a standard operating room or a radiology angiosuite), country of medical practice, and stage in training of the participants (whether trainee or specialist).

Data were processed and analysed using the R Statistical Package version 3.3.1.<sup>7</sup>

Fisher's exact test was used to perform univariate analysis for categorical variables, and effect sizes quantified using odds ratios with 95% confidence intervals. Multivariate logistic regression was used to assess the effect of access to a hybrid operating theatre, adjusting for the effect of country. A p-value of less than 0.05 was considered statistically significant. This study was assessed to be an evaluation of service and thus required no formal ethical approval.

## RESULTS

In total, there were 238 responses from 1001 members contacted (23.8%). 61 were received from the 196 ANZSVS members (31%), 65 from the 155 CSVS members (42%) and 112 from the 650 VSGBI members (17%). The response rates from the three societies were significantly different ( $p<0.001$ ). Of the 234 responders who stated a grade, 96% were consultant specialists. 52% of responders had access to a hybrid theatre whereas the remaining 48% did not. There was no significant difference in provision of hybrid theatres between ANZSVS (54%), CSVS (55%) and VSGBI (49%).

Endovascular repair was the most commonly chosen first line management strategy (46%) followed by ongoing surveillance (35%) then open surgical repair (14%). The breakdown between individual countries was varied, as outlined in Figure 2. In Great Britain and Ireland, ongoing surveillance was most prevalent (48%) followed by endovascular repair (38%). In Australia and New Zealand, 69% of responders chose an endovascular first strategy followed by 21% recommending ongoing surveillance. The majority of Canadian responders also advocated endovascular treatment (40%) with open repair being the next most common solution (34%).

In total, 35% of vascular specialists chose ongoing surveillance whilst 61% chose to intervene. The remaining 4% did not think intervention or surveillance was appropriate; this comprised 8 responders from VSGBI (7%) and 2 from ANZSVS (3%). Specialists in Great Britain and Ireland were more likely to adopt surveillance than their colleagues in Australia and New Zealand (odds ratio (OR) 3.41, 95% confidence interval (CI) 1.61-7.65;  $p<0.001$ ) and Canada (OR 2.61, 95% CI 1.29-5.47;  $p=0.0043$ ). Australian and New Zealand specialists were significantly more likely to offer endovascular repair than specialists in Canada (OR 3.28, 95% CI 1.50-7.40;  $p=0.0014$ ) and Great Britain and Ireland (OR 3.65, 95% CI 1.81-7.59;  $p<0.001$ ). Canadian specialists were significantly more likely to manage the aneurysm



with open surgery than colleagues in Great Britain and Ireland (OR 6.57, 95% CI 2.58-18.46;  $p<0.001$ ) or Australia and New Zealand (OR 7.18, 95% CI 2.22-30.79;  $p<0.001$ ). Access to a hybrid operating theatre did not significantly affect the initial treatment strategy (Table 1).

Of those choosing ongoing surveillance the median size at which to then intervene was 60 mm in all countries. The spread of treatment thresholds is shown in Figure 3. Choice of intervention at any threshold is outlined in Figure 4. Endovascular management was preferred by 80% of responders and open repair by the remaining 20%. When split into countries, 92% of interventions in Australia and New Zealand were endovascular compared to 83% in Great Britain and Ireland and 61% in Canada (Figure 5). The most common method of endovascular repair was FEVAR (84%) followed by EVAR with endoanchors (6%). The remaining 10% were a mixture of standard or chimney EVAR or EVAS (Figure 6).

## CONCLUSIONS

An unfit patient with an AAA unsuitable for standard EVAR approaching threshold for treatment is a common presentation globally. We aimed to investigate potential variability in treatments offered to a typical patient such as this, assess whether treatments differ across vascular specialists from different parts of the world, and characterize any potential differences using a survey. Vascular Societies from Canada, Australia and New Zealand, and Great Britain and Ireland were chosen to give a view of current vascular surgical practice across different countries.

There was heterogeneity in the management of the complex AAA case presented. Most surgeons surveyed would manage the patient operatively, with 61% choosing to intervene immediately. Endovascular repair was the most common first line management strategy for those who chose to intervene.

There were interesting differences in the management of the patient between countries. VSGBI specialists were significantly more likely to continue surveillance than both ANZSVS and CSVS. Canadian specialists were significantly more likely to perform open surgery than surgeons from Great Britain and Ireland or Australia and New Zealand, and ANZSVS were significantly more likely to treat the aneurysm with endovascular repair than VSGBI and CSVS. The same patient would therefore potentially be treated differently depending on which country they presented in. The operating environment which the surgeons had access to did not significantly vary between countries, and multivariate adjustment for this factor did not significantly affect initial treatment strategy (Table 1).

In all countries surveyed, endovascular management was the most popular choice of intervention once treatment threshold had been reached. Modern vascular training is changing to embrace the endovascular revolution with incorporation of interventional radiology

modules and assessments. It is however important to ensure that expertise in open surgical treatment of AAAs is maintained given the subset of patients for which this is likely to be the most durable and effective treatment. The endovascular alternatives outlined above have vastly increased the proportion of aneurysms which can be treated without open surgery, but long term data on their efficacy is lacking at present. Recent publication of the 15 year EVAR-1 results<sup>8</sup> has cast doubt on the durability of endovascular repair with increased total and aneurysm-related mortality in the EVAR arm from 8 years onwards, as well as re-intervention rate from 6 months onwards. If these findings were to be replicated in patients treated with complex EVAR it may lead to a paradigm shift in the treatment of AAA. Surgeons in countries heavily reliant on endovascular therapy are at risk of losing the skills developed over decades of open surgical practice, and the ability to pass these on to their trainees. This would potentially lead to difficulties providing a balanced and comprehensive set of aneurysm treatment options for all patients.

For those that chose to continue surveillance of the aneurysm prior to treatment, the treatment threshold demonstrated some variability with 23% choosing <60 mm, 70% choosing 60 mm and 7% choosing >60 mm. Despite the median threshold of 60 mm being the same in each of the 3 countries surveyed, the range of figures represent the difference in opinion between individual clinicians when making treatment decisions. This reflects variability in clinical practice throughout the world.<sup>9</sup>

Another influence on the specialist's decision making process that we must consider is the cost of the procedure. It has been established that patterns of reimbursement change the proportion of standard EVAR and the treatment threshold in different countries,<sup>10</sup> but this has not been assessed for management of complex AAA. Standard EVAR has been reported to be less cost-effective in elective cases,<sup>11</sup> but in systematic reviews of juxta-renal aneurysm

management there is insufficient comparative data to draw any cost-effectiveness conclusions.<sup>12</sup>

A survey-based method is in itself a limitation of this study. The response rate was significantly lower from the UK and Ireland (17%), with Canada having the highest rate at 42%, followed by Australia and New Zealand at 31%. Given the differences in response rates, particularly from practitioners in the UK and Ireland, the findings cannot be held as wholly representative. Further questions, including discovering the reasons for chosen management plans and volume of work in centers were considered, but the survey was kept brief and anonymous in an attempt to increase the response rate and reduce the likelihood of ‘survey fatigue’.

Other limitations included the inability of the online survey method to give a full 3D representation of the scans and a full consultation with the patient. Responding to the survey itself was optional, so our responders may have self-selected into a group which were particularly interested in the management of complex aneurysms.

In conclusion, our main finding in the results of this survey was the heterogeneity in management of a complex AAA among specialists worldwide. This could be explained by the lack of high level evidence demonstrating benefits of one therapeutic method over another.<sup>4</sup> The introduction of novel endovascular techniques such as EVAS, FEVAR and chimney grafts has been relatively recent, and long-term data on outcomes are awaited. In order to make the best and safest decisions with our patients, it is important that future research is carried out to inform us of the precise risks and benefits of each treatment method. This will be aided by the National Vascular Registry in the UK and Ireland, and counterparts from other countries. We believe that continuous monitoring of our practices and outcomes, both within individual units and internationally through audit and validated registries, and the

communication of good practice is vital to broaden the evidence base for complex aneurysm repair.

## **ACKNOWLEDGEMENTS**

G.K.A. was supported by a Royal College of Surgeons of England Research Fellowship.

None of the other authors obtained funding for the study.

## **REFERENCES**

1. Paravastu SC, Jayarajasingam R, Cottam R, Palfreyman SJ, Michaels JA, Thomas SM. Endovascular repair of abdominal aortic aneurysm. *Cochrane Database Syst Rev*. 2014;(1):CD004178.
2. Brown LC, Powell JT, Thompson SG, Epstein DM, Sculpher MJ, Greenhalgh RM. The UK EndoVascular Aneurysm Repair (EVAR) trials: randomised trials of EVAR versus standard therapy. *Health Technol Assess*. 2012;16(9):1-218.
3. Gupta PK, Ramanan B, Lynch TG, Gupta H, Fang X, Balters M et al. Endovascular repair of abdominal aortic aneurysm does not improve early survival versus open repair in patients younger than 60 years. *Eur J Vasc Endovasc Surg*. 2012;43(5):506-12.
4. Armstrong N, Burgers L, Deshpande S, Al M, Riemsma R, Vallabhaneni SR et al. The use of fenestrated and branched endovascular aneurysm repair for juxtarenal and thoracoabdominal aneurysms: a systematic review and cost-effectiveness analysis. *Health Technol Assess*. 2014;18(70):1-66.

5. Li Y, Hu Z, Bai C, Liu J, Zhang T, Ge Y et al. Fenestrated and Chimney Technique for Juxtarenal Aortic Aneurysm: A Systematic Review and Pooled Data Analysis. *Sci Rep*. 2016;6:20497.
6. Bristol Online Surveys. <https://www.onlinesurveys.ac.uk/>.
7. R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available from <https://www.R-project.org/>.
8. Patel R, Sweeting M, Powell JT, Greenhalgh RM, EVAR trial investigators. Endovascular versus open repair of abdominal aortic aneurysm in 15-years' follow-up of the UK endovascular aneurysm repair trial 1 (EVAR trial 1): a randomised controlled trial. *The Lancet*, Volume 388, Issue 10058, 2366-2374
9. Karthikesalingam A, Vidal-Diez A, Holt P, Loftus I, Schermerhorn M, Soden P et al. Thresholds for Abdominal Aortic Aneurysm Repair in England and the United States. *N Engl J Med*. 2016;375(21):2051-2059.
10. Beck AW, Sedrakyan A, Mao J, Venermo M, Faizer R, Debus S, et al on behalf of the International Consortium of Vascular Registries. Variations in Abdominal Aortic Aneurysm Care: A Report From the International Consortium of Vascular Registries. *Circulation*. 2016;134:1948-1958, originally published October 26, 2016  
<https://doi.org/10.1161/CIRCULATIONAHA.116.024870>
11. Epstein, D., Sculpher, M. J., Powell, J. T., Thompson, S. G., Brown, L. C. and Greenhalgh, R. M. (2014), Long-term cost-effectiveness analysis of endovascular *versus* open repair for abdominal aortic aneurysm based on four randomized clinical trials. *Br J Surg*, 101: 623–631. doi:10.1002/bjs.9464

12. Armstrong N, Burgers L, Deshpande S, Al M, Riemsma R, Vallabhaneni SR et al.

The use of fenestrated and branched endovascular aneurysm repair for juxtarenal and thoracoabdominal aneurysms: a systematic review and cost-effectiveness analysis.

Health Technol Assess. 2014;18(70):1-66.